

Claims

What is claimed is:

- 1 1. A computer comprising:  
2 at least one central processing unit;  
3 at least one fan disposed for providing cooling to said at least one  
4 central processing unit; and  
5 a thermal manager, said thermal manager for monitoring a  
6 temperature of said at least one central processing unit and dynamically  
7 controlling a throttling of said at least one central processing unit and said at  
8 least one fan according to a thermal management algorithm.
- 1 2. The computer of claim 1, wherein the thermal management algorithm  
2 enables stabilization of the temperature of said at least one central  
3 processing unit below a prescribed temperature threshold over a given  
4 duration of time.
- 1 3. The computer of claim 2, wherein the temperature threshold includes body  
2 temperature.
- 1 4. The computer of claim 1, wherein said thermal manager further includes at  
2 least one basic input output system (BIOS) table, the at least one BIOS table  
3 identifying specific cooling actions to be implemented as a function of the  
4 temperature of the at least one central processing unit.

1 5. The computer of claim 1, further comprising a user setup routine, wherein  
2 said user setup routine enables a user to select a desired thermal operation  
3 mode for said thermal manager, the thermal operation modes including at  
4 least one of the following selected from the group consisting of (a) OFF  
5 Mode, wherein the OFF Mode disables a dynamic thermal management by  
6 said thermal manager, (b) ON Mode, wherein the ON Mode enables dynamic  
7 thermal management by said thermal manager, and (c) AUTO Mode, wherein  
8 the AUTO Mode enables and disables dynamic thermal management by said  
9 thermal manager according to a prescribed computer operational  
10 characteristic.

1 6. The computer of claim 5, wherein the prescribed computer operational  
2 characteristic includes at least one of the following selected from the group  
3 consisting of AC power mode, AC power with battery present mode, AC  
4 power mode with battery present and charge mode, AC power with battery  
5 absent mode, DC power mode, and computer docked mode with AC power.

1 7. The computer of claim 5, wherein the user setup routine includes AUTO  
2 Mode for a default setting, requiring no user input.

1 8. The computer of claim 5, wherein the OFF Mode is characterized by a first  
2 thermal management algorithm, the ON Mode is characterized by a second  
3 thermal management algorithm, and the AUTO Mode is characterized by a  
4 third thermal management algorithm.

1 9. The computer of claim 8, wherein the first thermal management algorithm  
2 includes a thermal management algorithm of the computer absent any  
3 dynamic thermal management, wherein the second thermal management  
4 algorithm includes at least one of the following selected from the group  
5 consisting of (a) adjusting the thermal temperature threshold to be lower than  
6 body temperature, (b) enabling a smart CPU feature contained in a basic  
7 input output system (BIOS) of said computer, and (c) giving priority to said at  
8 least one fan if said computer is in an AC power mode, and wherein the third  
9 thermal management algorithm includes at least one of the following selected  
10 from the group consisting of (a) if said computer is docked in a docking  
11 station, then assume dynamic thermal management is in OFF Mode and do  
12 not adjust any temperature thresholds, (b) if said computer is not docked,  
13 then adjust the temperature thresholds to below body temperature, (c) if said  
14 computer is in AC power mode, then give thermal management priority to the  
15 at least one fan for holding the temperature of the at least one central  
16 processing unit down, and (d) if in DC power mode, utilize a new temperature  
17 threshold that is lower than body temperature for activation of thermal  
18 management by said thermal manager.

1 10. The computer of claim 9, wherein the smart CPU feature includes a function  
2 in BIOS for putting said at least one central processing unit into at least one  
3 low power state, wherein a cooling action may include said thermal manager  
4 causing the smart CPU feature to put said at least one central processing unit  
5 into the low power mode, even if said at least one central processing unit is  
6 not idle.

1 11. The computer of claim 10, wherein said thermal manager intermittently calls  
2 the smart CPU feature to effectively reduce a rate of rise in central  
3 processing unit temperature.

**PATENT**

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- 1 12. The computer of claim 1, wherein said computer further comprises a laptop  
2 computer and said thermal manager maintains a temperature of a case of  
3 said computer proximate a location of said at least one central processing  
4 unit to no more than body temperature.
- 1 13. The computer of claim 1, wherein said thermal manager is operable upon  
2 launching of an operating system of said computer.
- 1 14. The computer of claim 13, wherein said thermal manager is further operable  
2 according to an enable, disable, and automatically enable/disable option via a  
3 graphical user interface control application.
- 1 15. The computer of claim 13, wherein the operating system includes a CPU  
2 temperature reading function.
- 1 16. The computer of claim 13, wherein said thermal manager carries out thermal  
2 management via a system management basic input output system  
3 (SMBIOS), further wherein a system management interrupt (SMI) triggers  
4 each time the temperature of said at least one central processing unit falls  
5 outside of a given temperature range, and responsive thereto, said thermal  
6 manager invokes a corresponding cooling action according to the thermal  
7 management algorithm.
- 1 17. The computer of claim 16. wherein the thermal management algorithm is  
2 characterized by thermal tables representative of various conditions that  
3 include at least DC power mode and AC power mode, respectively, further  
4 wherein said thermal manager switches the thermal tables in and out  
5 dynamically in response to an SMI representative of a respective condition.

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1 18. The computer of claim 17, further wherein said thermal manager utilizes  
2 advanced configuration and power interface (ACPI) functions for returning the  
3 central processing unit temperature reading, enabling thermal management,  
4 and disabling thermal management.

1 19. A thermal management method in a computer including at least one central  
2 processing unit and at least one fan disposed for providing cooling to the at  
3 least one central processing unit, said method comprising:

4 monitoring a temperature of the at least one central processing  
5 unit; and

6 responsive to the monitored temperature and in accordance with a  
7 thermal management algorithm, dynamically controlling (i) a throttling of the  
8 at least one central processing unit and (ii) operation of the at least one fan  
9 for enabling stabilization of the temperature of the at least one central  
10 processing unit below a prescribed temperature threshold over a given  
11 duration of time.

1 20. The method of claim 19, wherein the temperature threshold includes body  
2 temperature.

1 21. The method of claim 19, further comprising, utilizing at least one basic input  
2 output system (BIOS) table for the thermal management algorithm, the at  
3 least one BIOS table identifying specific cooling actions to be implemented as  
4 a function of the temperature of the at least one central processing unit.

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1 22. The method of claim 19, further comprising, utilizing a user setup routine for  
2 enabling a user to select a desired thermal management operation mode for  
3 dynamically controlling thermal management, the thermal operation modes  
4 including at least one of the following selected from the group consisting of  
5 (a) OFF Mode, wherein the OFF Mode disables dynamic thermal  
6 management, (b) ON Mode, wherein the ON Mode enables dynamic thermal  
7 management, and (c) AUTO Mode, wherein the AUTO Mode enables and  
8 disables dynamic thermal management according to a prescribed computer  
9 operational characteristic.

1 23. The method of claim 22, wherein the prescribed computer operational  
2 characteristic includes at least one of the following selected from the group  
3 consisting of AC power mode, AC power with battery present mode, AC  
4 power mode with battery present and charge mode, AC power with battery  
5 absent mode, DC power mode, and computer docked mode with AC power.

1 24. The method of claim 22, wherein the OFF Mode is characterized by a first  
2 thermal management algorithm, the ON Mode is characterized by a second  
3 thermal management algorithm, and the AUTO Mode is characterized by a  
4 third thermal management algorithm.

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1 25. The method of claim 24, wherein the first thermal management algorithm  
2 includes a thermal management algorithm of the computer absent any  
3 dynamic thermal management, wherein the second thermal management  
4 algorithm includes at least one of the following selected from the group  
5 consisting of (a) adjusting the thermal temperature threshold to be lower than  
6 body temperature, (b) enabling a smart CPU feature contained in a basic  
7 input output system (BIOS) of the computer, and (c) giving priority to the at  
8 least one fan if the computer is in an AC power mode, and wherein the third  
9 thermal management algorithm includes at least one of the following selected  
10 from the group consisting of (a) if the computer is docked in a docking  
11 station, then assume dynamic thermal management is in OFF Mode and do  
12 not adjust any temperature thresholds, (b) if the computer is not docked, then  
13 adjust the temperature thresholds to below body temperature, (c) if the  
14 computer is in AC power mode, then give thermal management priority to the  
15 at least one fan for holding the temperature of the at least one central  
16 processing unit down, and (d) if in DC power mode, utilize a new temperature  
17 threshold that is lower than body temperature for activation of thermal  
18 management.

1 26. The method of claim 25, wherein the smart CPU feature includes a function  
2 in BIOS for putting the at least one central processing unit into at least one  
3 low power state, wherein a cooling action may include said thermal manager  
4 causing the smart CPU feature to put said at least one central processing unit  
5 into the low power mode, even if the at least one central processing unit is  
6 not idle.

1 27. The method of claim 26, wherein dynamically controlling further includes  
2 intermittently calling the smart CPU feature to effectively reduce a rate of rise  
3 in central processing unit temperature.

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1 28. The method of claim 19, wherein the computer is a laptop computer and said  
2 dynamically controlling step maintains a temperature of a case of the  
3 computer proximate a location of the at least one central processing unit to  
4 no more than body temperature.

1 29. A method of upgrading thermal management in a computer having at least  
2 one central processing unit and at least one fan disposed for providing  
3 cooling to said at least one central processing unit; said method comprising:  
4 installing a thermal manager in a basic input output system (BIOS) of  
5 the computer; and

6 storing at least one thermal management algorithm in the BIOS  
7 computer, wherein the thermal manager operable for monitoring a  
8 temperature of the at least one central processing unit and for dynamically  
9 controlling a throttling of the at least one central processing unit and the at  
10 least one fan according to the at least one thermal management algorithm,  
11 wherein the thermal management algorithm enables stabilization of the  
12 temperature of the at least one central processing unit below a prescribed  
13 temperature threshold over a given duration of time.

1 30. The method of claim 29, further comprising utilizing at least one basic input  
2 output system (BIOS) table for the thermal management algorithm, the at  
3 least one BIOS table identifying specific cooling actions to be implemented as  
4 a function of the temperature of the at least one central processing unit.



1 31. The method of claim 29, further comprising utilizing a user setup routine for  
2 enabling a user to select a desired thermal management operation mode for  
3 dynamically controlling thermal management, the thermal operation modes  
4 including at least one of the following selected from the group consisting of  
5 (a) OFF Mode, wherein the OFF Mode disables dynamic thermal  
6 management, (b) ON Mode, wherein the ON Mode enables dynamic thermal  
7 management, and (c) AUTO Mode, wherein the AUTO Mode enables and  
8 disables dynamic thermal management according to a prescribed computer  
9 operational characteristic.

1 32. The method of claim 31, wherein the prescribed computer operational  
2 characteristic includes at least one of the following selected from the group  
3 consisting of AC power mode, AC power with battery present mode, AC  
4 power mode with battery present and charge mode, AC power with battery  
5 absent mode, DC power mode, and computer docked mode with AC power.

1 33. The method of claim 31, wherein the OFF Mode is characterized by a first  
2 thermal management algorithm, the ON Mode is characterized by a second  
3 thermal management algorithm, and the AUTO Mode is characterized by a  
4 third thermal management algorithm.